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Research Article

Price Discovery and Causality in the Guargum Trading in India

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Abstract:

The purpose of this paper is to determine Whether spot price or future price plays vital role in price discovery of Guargum and to what extent . The data for study is the daily closing prices of spot and stock futures of Guargum. Dickey fuller Philip-Perron test, Cointegration test, Granger causality test, Impulse response function and Variance decomposition is conducted . The results of study indicate that the spot market spot price dominates over future market. The study of dynamic price relationship between Guargum spot and futures prices will be usefull for the traders, regulatory bodies, practitioners, and academicians for price discovery, hedging and arbitrage opportunities. This paper describes and analyzes weather spot or future price lead in price discovery.
Keywords: Guargum, cointegration, Causality, Price discovery, unrestricted VAR, Impulse response, Variance decomposition
JEL Classification: C13, C32, G13, G14, M31, M38, Q13

I. INTRDUCTION

Futures market is supposed to help the market participants through two vital economic functions, viz., Price Discovery and Price Risk Management. Price discovery is a process through which financial markets converge and reach the efficient equilibrium price. This helps in bringing about reasonable stability in the prices of commodities and supports farmers to get remunerative prices without adversely affecting consumer's interest. Such a market also provides a market-based alternative to government involvement like procurement at Minimum Support Price and Public Distribution System. There are excessive fluctuation in Guargum . Guargum price has increased 420 times in the last seven months. NCDEX accounts for more than 95% of guar volumes in India, which meets about 80% of world demand for guar. The gum extracted from guar seed is used as a controlling agent in crude oil drilling, among other industrial uses.

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This study is a part of research to investigate long run and short run causality between selected agricultural commodities of NCDEX spot price and future prices of India. The data for study is the daily closing prices of spot and futures of chana,Soyabean,soyarefined,Guargum,Potato and Pepper. We found strong evidence of cointegration between the daily spot and one-month futures commodity prices of chana,soyabean,soya oil and pepper. We have not found any correlation between guargum and potato future and spot price. Since there is no cointegration between Potato spot and future prices. We used unrestricted VAR model to measure linkages between spot and future prices.

II. LITERATURE SURVEY

R. Sendhil et al(2010) has examined the efficiency of futures trading in wheat, chickpea, maize and barley in terms of price transmission, price discovery and extent of volatility in prices. The study has indicated that futures are more efficient in price discovery of wheat and maize.Kailash Chandra Pradhan, K. Sham Bhat study investigated price discovery, information and forecasting in Nifty futures markets. *Johansen's (1988)* Vector Error Correction Model (VECM) is employed to investigate the causal relationship between spot and futures prices. This study compares the forecasting ability of futures prices on spot prices with three major forecasting techniques namely ARIMA, VAR and VECM model. The results show clearly the importance of taking into account the long-run relationship between the futures and the spot prices in forecasting future spot prices. Pratap Chandra Pati and Purna Chandra Padhan examined the price discovery process and lead-lag relationship between NSE S&P CNX Nifty stock index futures and its underlying spot index. It investigates the long-term and short-term dynamics of prices between spot and futures market, using Johansen-Juselius cointegration test, Vector Error Correction Model (VECM), impulse response functions, and variance decomposition. The results support the existence of a long-run relationship between spot and futures prices. Further, VECM indicates short-run unidirectional causality from futures to spot market. In addition, the study finds unidirectional Granger causality from futures market to spot market through Toda-Yamamoto-Dolado-Lütkepohl (TYDL) causality test.

K. Srinivasan, Malabika Deo employed Johansen's Cointegration test and Vector Error Correction Model (VECM) for analyzing the long run and speed of equilibrium between the between Mini gold spot and futures market by taking daily closing values for both the indices The findings of the study reveal that in the long run, both the markets are cointegrated and causal relationship exists between these two markets. The results shows that unidirectional causality is running from spot to futures market in long-run dynamics and spot market serves as a primary market for price discovery.

Adamopoulos Antonios investigated the causal relationship between stock market development and credit market development for Spain using a vector error correction model (VECM). The purpose of this paper is to examine the long run relationship between these variables applying the Johansen cointegration analysis. Granger causality tests discovered a unidirectional causality between credit market development and stock market development with direction from credit market to stock market development and there is a unidirectional causal relationship between stock market development .The direction is from productivity to stock market development for Spain. Therefore, it can be inferred that credit market development and productivity have a positive effect on stock market development.

T Mallikarjunappa and *E M Afsal* found no significant leading or lagging effects in either spot or futures markets with respect to top twelve individual stocks. There exists a contemporaneous and bi-directional lead-lag relationship between the spot and the futures markets. As against the widely accepted hypothesis of futures market, with its cost and hedging advantages, leading the spot market, Indian futures market fails to supply early information to spot market.

Maran Marimuthu, Ng Kean Kok attempted to re-examine the dynamic relationship between the Malaysian, and the Tiger markets (Hong Kong, South Korea, Singapore and Taiwan). The Johansen multivariate cointegration test ,VECM using a five-variable and Granger causality test are used to find correlation and lead lag. The results indicate that there is a long run relationship among the five markets and that the Hong Kong and Taiwan markets appear to be the most influential markets in this region.

P. Srinivasan, K. Sham Bhat applied Johansen's Cointegration technique followed by the Vector Error Correction Model (VECM) to examine the lead-lag relationship between NSE spot and futures market for selected twenty-one commercial banking stocks of India. The analysis reveals mixed findings. However, most of the selected commercial bank stocks in India reveal future leads to spot `and equal number of selected banking stocks reveals bi-directional and spot lead to future prices.

Janchung Wang studied empirical evidence related to futures pricing for the SGX FTSE Xinhua China A50 and HKE share index futures markets. He investigated whether the cost of carry model can describe the relationship between index futures prices and underlying stock indexes. The results says that incorporating stock market volatility into pricing models appears beneficial for estimating prices on these two index futures.

*Raymond L*i evaluates the relationship among the NYMEX futures prices for crude oil, unleaded gasoline, heating oil and the US trade-weighted exchange rate to determine the relationship between the US exchange rate and energy prices. In addition, the causal relationships among the energy futures prices are examined. Cointegration is detected among the variables, but contrary to the existing empirical literature, it is found that the US exchange rate can be excluded from the cointegrating space. The Granger causality tests and impulse response functions also indicate that the US exchange rate is not related to the energy prices.

Tarık Doğru,Ümit Bulut examine the relation between closing prices and trading volume of US Dollar (USD) futures contracts in the Turkish Derivatives Exchange (TURKDEX). The results indicate that while there is not a relation between prices and volume in the short run, there is a relation that is from volume to prices in the long run. Accordingly, it may be said that the futures market in Turkey is not efficient by the efficient market hypothesis.

Kaoru Kawamoto, Shigeyuki Hamori explored market efficiency and unbiasedness among such futures are defined and the concept of "consistently efficient (or consistently efficient and unbiased) market within n-month maturity" is introduced. Market efficiency and unbiasedness among WTI futures with different maturities are tested using cointegration analysis, and short-term market efficiency, using error correction model and GARCH-

M-ECM. The results show that WTI futures are consistently efficient within 8-month maturity and consistently efficient and unbiased within 2-month maturity.

Christos Floros examines the price discovery between futures and spot markets in South Africa over the period 2002 to 2006. He employed four empirical methods: (i) a cointegration test, (ii) a Vector Error Correction model, (iii) a Granger causality test, and (iv) an Error Correction model with TGARCH errors. Empirical results show that FTSE/JSE Top 40 stock index futures and spot markets are cointegrated. Furthermore, Granger causality, VECM and ECM-TGARCH(1,1) results suggest a bidirectional causality (feedback) between futures and spot prices.

T. H. ROOT and *D. LIEN* estimated generalized impulse response functions that result from exogenous shocks to a threshold error correction model of the natural gas futures market. The estimation results of the threshold model indicate that it is an appropriate model of the natural gas futures market. Therefore the calculation of impulse responses should account for both the size of the shock and the history of the series. This is accomplished via a generalized impulse response function. Calculation of the generalized impulse response functions indicates that the length of the futures contract is an important determinant of the ability of the system to return to its long run equilibrium following a shock.

III. MODEL SPECIFICATION

The empirical analysis of data reveals that the log of both spot and futures price series is non-stationary at levels, but stationary at their first differences. We found that there is no correlation between spot and future prices of Guar. So we applied vector autoregression , impulse response function, and variance decomposition to study the movement of spot and future prices.

Johansen's cointegration test

Johansen's cointegration test has been applied to test the long-run relationship between spot and futures prices, which is investigated by estimating the following:

$$\Delta Yt = \Pi Y_{t-k} \sum_{i=1}^{k-1} \Gamma i \ \Delta Y_{t-i} + \varepsilon_t \ \ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

$$\text{Where } \Pi = \sum_{j=1}^{k} A_j - \mathrm{I} \text{ and } \Pi_i = \sum_{j=1}^{i} A_j - \mathrm{I} \ldots\ldots\ldots\ldots\ldots (2)$$

Yt = [ln S_t ln F_t ln Ft]' is a (2 x 1) vector of non-stationary log-spot and log-futures prices; ΔY_t = [dln St dln Ft]' is a (2 x 1) column vector first differenced series; $\varepsilon_t = [\varepsilon_{s,t}\ \varepsilon_{ft}]'$ is a (2 x 1) column vector of white noise Gaussian error; A0 is a (2 x 1) column vector of constants; and Ai is a (2 x 2) matrix of coefficients.

The existence of cointegrating relations among the variables can be examined through the Π matrix. Mathematically, the Π matrix can be rewritten as $\Pi=\alpha\beta'$, where α and β are n x r matrices of rank r. Here, β represents the matrix of cointegrating parameters and α is the matrix of the speed of adjustment parameters. The test for cointegration between the Ys is calculated by looking at the rank of the Π matrix via eigen values.

Johansen developed two likelihood ratio tests for testing the number of cointegrating vectors (r)—the trace test and the maximum eigenvalue test. The trace statistic (λ_{max}) tests the null hypothesis of r = 0 (i.e., no cointegration) against the alternative of r > 0, i.e., there is one or more cointegrating vectors. The maximal eigenvalue test statistic (λ_{max}) examines the null hypothesis that the number of cointegrating vectors are less than or equal to r against the alternative of r + 1.

Granger Causality

For granger causality we will test : Is it spot price that "causes" the future price F (S→ F) or is it the future price that causes spot price (F→S), where the arrow points to the direction of causality. The Granger causality test assumes that the information relevant to the prediction of the respective variables, F and S, is contained solely in the time series data on these variables. The test involves estimating the following pair of regressions:

$$F_t = \sum_1^n \alpha_i S_{t-i} + \sum_{j=1}^n \beta_j F_{t-j} + u_{1t} \ldots\ldots\ldots\ldots\ldots\ldots(3)$$

$$S_t = \sum_1^n \lambda_i S_{t-i} + \sum_{j=1}^n \delta_j F_{t-j} + u_{2t} \ldots\ldots\ldots\ldots\ldots\ldots\ldots.(4)$$

where it is assumed that the disturbances u1t and u2t are uncorrelated. since we have two variables, we are dealing with bilateral causality.Eq(3) postulates that current future price related to past values of itself as well as that of S, and eq.(4) postulates a similar behavior for (Damodar N.Gujrati).

Impulse Response

We saw that when we introduced ten lags of each variable as regressors, we could not reject the hypothesis that there was bilateral causality between future and spot price. That is, spot affects future and future affects spot. These kinds of situations are ideally suited for the application of VAR.

one can estimate each of the following equations by OLS.

$$S_{1t} = \alpha + \sum_{j=1}^k \beta_j S_{t-j} + \sum_{j=1}^k \gamma_j R_{t-j} + u_{1t} \ldots\ldots\ldots..(5)$$

$$F_t = \alpha + \sum_{j=1}^k \theta_j S_{t-j} + \sum_{j=1}^k \gamma_j R_{t-j} + u_{2t} \ldots\ldots\ldots\ldots(6)$$

where the u's are the stochastic error terms, called impulses or innovations or shocks in the language of VAR.

IV. DATA AND PRELIMINARY ANALYSIS

The data used in this study consists of daily closing prices of Guar spot price and future prices. The period of data is from November 2006 to February 2012 . All the required data information for the study has been retrieved from the National Commodity Exchange of India(NCDEX) website.

Since most trading activities take place in near month contract, only near month contract data are examined. The daily continuous compound return is defined as the first logarithmic difference of closing prices on consecutive trading days, i.e., dln St = (ln St – ln St–1) and dln Ft = (ln Ft – ln Ft–1).

Table I: Descriptive Statistics of Future and Spot Price Return of Guargum

	$\mathbf{dl_nS_t}$	$\mathbf{dl_nF_t}$
Mean	0.001772	0.00176
Median	0.000747	0.001071
Std. Deviation	0.018331	0.019061
Skewness	-0.566717	-1.197724
Kurtosis	19.26262	21.00036
Jarque-Bera	17661.81	21942

The average means of future and spot are almost equal for the sample period. The future volatility is greater than the spot price volatility as revealed by standard deviation. This is to be expected as the futures market is regarded as a source of price stability in the spot market. The negative skewness coefficients indicate that frequency distribution of futures and spot returns series are negatively skewed or have longer tail to the left. The unconditional distribution of both spot and futures returns exhibit fat tails and excessive peak at the mean than the corresponding normal distributions. The non-normality is also confirmed by Jarque-Bera test where the null hypothesis is that the given series is normally distributed. Here the Jarque-Bera statistic is highly statistically significant for both spot and futures returns series, and hence we reject the null hypothesis of normality.

Figure I shows that the two series are not stationary. while Figure II shows that the logarithmic first differences of spot and futures appear to be oscillating around a constant value, indicating stationary behavior.

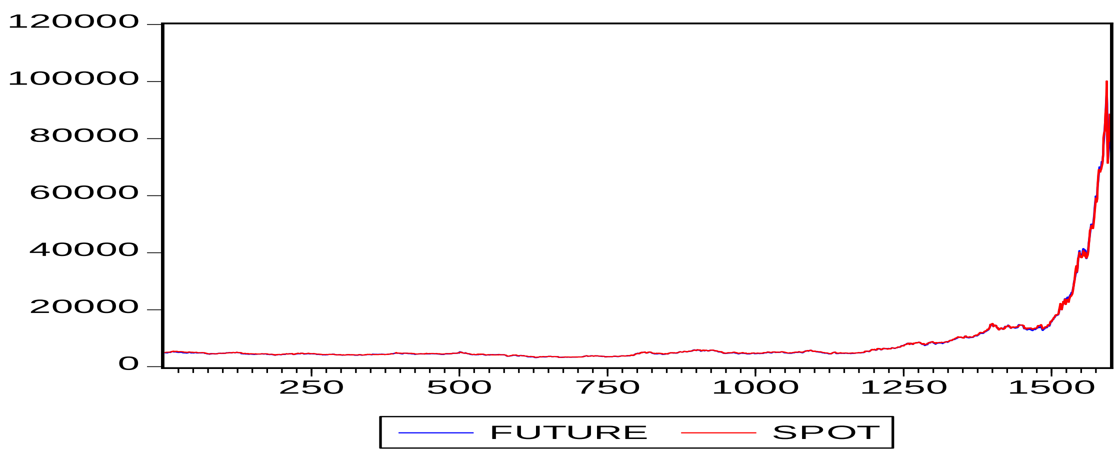

Figure I

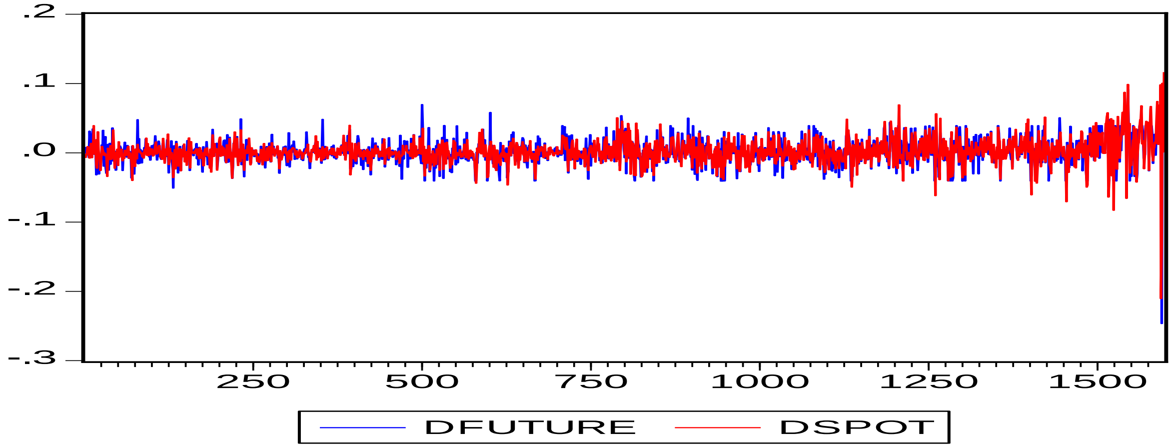

Figure II

As a preliminary investigation, Augmented Dickey Fuller and Phillip Perron tests were employed to test the stationarity of spot and future price series of selected agricultural commodities and its results are presented in Table-II.

Table II

			Augmented Dickey-Fuller test statistic		Phillips-Perron test statistic	
			t-Statistic	Prob. *	t-Statistic	Prob.*
Guargum	Future	With Intercept	6.140315	1	12.42961	1
		With Intercept and Trend	3.716311	1	10.42014	1
		Without Intercept and Trend	3.681838	1	9.40976	1
		First Difference	-35.5023	0	-31.47536	0
	Spot	With Intercept	7.031055	1	47.95191	1
		With Intercept and Trend	4.481443	1	45.77943	1
		Without Intercept and Trend	3.445325	0.9999	7.965185	1
		First Difference	-15.2239	0	-34.02973	0

Note: * – indicates significance at one per cent level.

The above Table -II result reveals that both the data series of future and spot price of Guargum are stationary after first difference. Johansen's Cointegration test is performed to examine the long-run relationship between spot and future markets of guargum and its results are presented in Table-IV.

The estimation procedure of Johansen and Juselius (1990) cointegration test is based on maximum likelihood estimation with a VAR model. However, prior to the application of VAR model, the selection of lag length is important. The AIC, SIC, HQ, FPE and LR statistics can be applied to determine the VAR order (i.e., lag length, k). The resulting lag structures are reported in Table III. The optimal lag length is eight.

Table -III

Lag	Log L	LR	FPE	AIC	SC	HQ
0	8602.675	NA	6.37E-08	-10.89383	-10.88703	-10.8913
1	8837.584	468.9239	4.75E-08	-11.1863	-11.16592	-11.17873
2	8877.436	79.45143	4.54E-08	-11.23171	-11.19774	-11.21909
3	8894.096	33.17257	4.47E-08	-11.24775	-11.20018	-11.23007
4	8916.418	44.39088	4.37E-08	-11.27095	-11.2098	-11.24823
5	8934.053	35.02276	4.29E-08	-11.28822	-11.21348*	-11.26045*
6	8939.125	10.06113	4.29E-08	-11.28958	-11.20125	-11.25676
7	8946.902	15.40684	4.27E-08	-11.29437	-11.19244	-11.25649
8	8953.385	12.82525*	4.25e-08*	-11.29751*	-11.182	-11.25459

Note: * indicates lag order selected by the criterion; LR: sequential modified LR test statistic (each test at 5% level); FPE: Final prediction error; AIC: Akaike information criterion; SC: Schwarz Information criterion.

Table-IV: Johansen's Cointegration Test Results

Commodity	Hypothesized No. of CE(s)	Eigen Value	Trace Statistic	Critical Value	Prob.**
Guargum	None *	0.064171	144.7169	15.49471	0.0001
	At most 1 *	0.02456	39.46387	3.841466	0

Note : * denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

The Table-IV result reveals that there is no co-integration vector between Future and spot prices of Guargum. Since there is no cointegration between Guargum spot and future prices. We will use unrestricted VAR model to measure linkages between spot and future prices.

Table V

Null Hypothesis:	Obs	F-Statistic	Probability
DFUTURE does not Granger Cause DSPOT	1579	30.3644	1.9E-44
DSPOT does not Granger Cause DFUTURE		8.87517	6.0E-12

Table V measures granger causality between spot and future price of Guargum. It is proved that
We reject Null hypothesis which states that future doesn't granger cause spot price and spot does not granger cause future price at 5% significance level. Hence there is bidirectional causality between spot and future price of Guargum.

To find more detailed study of VAR model , impulse response function and variance decomposition are estimated. Figure III illustrates the estimated impulse response functions for ten days ahead time horizons. The graphs of impulse response functions depicted in Figure II have been plotted for ten periods ahead forecasting horizon

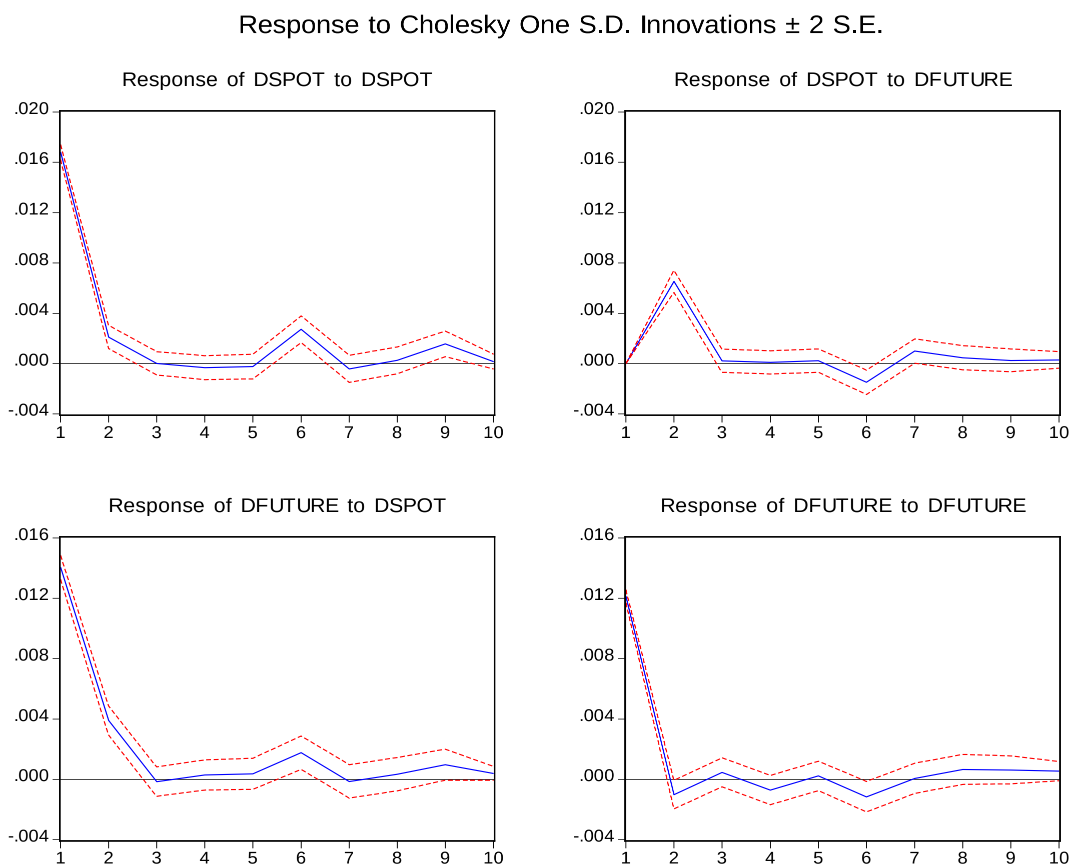

Figure III

It is evident from the shape of the impulse response graphs that future market has a larger response to one standard deviation shocks to the spot price than the spot responses to future innovations .Initially, the response of spot price to shocks to futures prices is fluctuating for the 3 days .It remain constant from 3 to 5th day and then started fluctuating. . It is flat fron 7 th day till 10th day. On the other hand, response of futures price to shocks to spot prices is strong initially, it is decaying till 3rd day and it fluctuates more or less at low level. The response of future price is higher than the response of spot prices comparatively. Thus, it can be concluded from the analysis that spot price leads more as compared future price .

The forecast error variance decomposition provides an alternative way to look at the finding of the impulse response analysis. It enables in innovating the extent to which a variable helps in explaining the other variables.

Table VI

Panel A: Variance Decomposition of SPOT:			Panel B:Variance Decomposition of FUTURE:		
Period	DSPOT	DFUTURE	Period	DSPOT	DFUTURE
1	100.00	0.00	1	57.28	42.72
2	87.04	12.96	2	58.92	41.08
3	87.03	12.97	3	58.88	41.12
4	87.03	12.97	4	58.81	41.19
5	87.02	12.98	5	58.82	41.18
6	86.74	13.26	6	58.95	41.05
7	86.49	13.51	7	58.96	41.04
8	86.44	13.56	8	58.90	41.10
9	86.52	13.48	9	58.95	41.05
10	86.50	13.50	10	58.92	41.08

The estimates of the variance decomposition are reported in Table VI for ten-day time horizons. The reported figures in Panel A shows the forecast error variance decomposition of spot return. It explains a high level of forecast error variance of itself. At the initial period, it explains 100% variation in its forecast error, but after that it shows a decreasing trend. However, only a small percentage changes in forecast error of spot market is explained by the future market, though over the period of time it shows an increasing trend, but the rate of increase is initially high and then very low. It means spot leads to future. In Panel B However, a high percentage changes in forecast error of futures market is explained by the spot market(57.28%),though over the period of time it shows an increasing trend, but the rate of increase is very low. Hence it is proved that in case of Guargum spot price leads to future.

V. CONCLUSION

This paper explores the price discovery role and lead-lag relationship between spot and future price of Guargum. Both the data series of future and spot price of Guargum are stationary after first difference. From the Johansen-Juselius test, it can be concluded that there is no cointegration between spot and futures prices. However, the study finds bidirectional Granger causality from futures market to spot.The shape of the impulse response graphs that future market has a larger response to one standard deviation shocks to the spot price than the spot responses to future innovations . The results of variance decomposition indicate that the spot market shocks dominate over future market. A high percentage changes in forecast error of futures market is explained by the spot market(57.28%),though over the period of time it shows an increasing trend, but the rate of increase is very low. Hence it is proved that in case of Guargum spot price leads to future.

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